REMARKS:

1) The Office Action Summary indicates that the Final Office Action is "Responsive to communication(s) filed on 11 September 2001". That refers to our Response mailed on September 6, 2001. After that, we also filed a Voluntary Supplemental Amendment and Letter to the Drawing Review Branch including proposed corrections in the drawings on October 3, 2001 (received in the USPTO on October 9, 2001), and a further Supplemental Drawing Correction that we filed by telefax on October 25, 2001 and by mail on October 26, 2001 (received in the USPTO on January 31, 2002). The Examiner is respectfully requested to consider and enter the Voluntary Supplemental Amendment of October 3, 2001, and the drawing corrections of October 3, 2001 and October 25, 2001. Also, please acknowledge receipt and entry of these supplemental papers in the next official communication.

2) Entry and consideration of the present Amendment and Remarks after Final are respectfully requested. The Examiner has applied a new reference (Woodard et al.) in a new rejection for the first time in the Final Office Action. The present Response is applicants' first opportunity to reply to the new grounds of rejection involving the new reference. Also, the present Response does not introduce any new issues that would require further search or consideration. Entry and consideration hereof after Final are appropriate.

3) Claim 1 has been amended to incorporate the subject matter of prior claim 7 (without the intervening prior claim 4). Particularly, claim 1 now recites that the n-type transparent conductive film is formed by laser ablation and has properties as result from the laser ablation. This is not merely a "product-by-process" feature, but rather is a physical structural limitation, because the n-type transparent conductive film must have properties that result from the laser ablation. This amendment of claim 1 is supported by prior claim 7 and the original disclosure (e.g. page 6, line 6 to page 7, line 19; page 12, line 10 to page 14, line 14), and does not involve any new matter. A marked-up version of amended claim 1 is enclosed. Entry of the amendment is respectfully requested.

4) The Final Office Action does not expressly make a rejection of prior claim 6. Instead, only claims 1, 4, 5 and 7 were expressly rejected. Near the middle of page 3 of the Office Action, the Examiner states "*with regard to claims 4-6, please see the description of record*". It is not clear whether this statement is intended to be a rejection of claim 6. It is respectfully submitted that claim 6 should be recognized as containing allowable subject matter, in view of the absence of any express prior art rejection.

5) Referring to pages 2 to 3 of the Office Action, the rejection of claims 1, 4 and 5 as obvious over U. S. Patent 5,617,446 (Ishibashi et al.) in view of JP 06-318406 (Kazuyoshi et al.) and U. S. Patent 6,255,003 (Woodard et al.) has been obviated because

amended claim 1 now includes subject matter from prior claim 7, which was not included in this rejection. Nonetheless, the points of this rejection will be discussed in connection with the following rejection of original claim 7.

6) Referring to the bottom of page 3 of the Office Action, the rejection of claim 7 as obvious over Ishibashi et al. in view of Kazuyoshi et al. and further in view of U. S. Patent 6,107,641 (Mei et al.) is respectfully traversed. This rejection has been obviated as to cancelled claim 7, but will be discussed in connection with the above rejection, as these two rejections might be related to amended claim 1.

7) Amended claim 1 is directed to a semiconductor light-emitting device comprising a combination of features in a layered structure that was already defined in prior claim 1. The present twice-amended claim 1 further recites that the n-type transparent conductive film is formed by laser ablation and has properties as result from the laser ablation.

8) The features of prior claim 1 relating to the structural layered arrangement have been discussed in comparison to Ishibashi et al., Kazuyoshi et al. and Mei et al. in applicants' prior Response dated September 6, 2001. Applicants' prior remarks in this regard are expressly incorporated herein by reference, and reasserted in reply to the Final Office Action. The Examiner is respectfully requested to review at least remark sections 10) to 14) on pages 6 to 9 of the prior Response.

9) Regarding the structural arrangement of the present light-emitting device, it is most important that there is an Au thin film having a **thickness of 1 nm to 3 nm** arranged **between** a p-type semiconductor layer and an n-type transparent conductive film. This Au film plays a significant role as follows.

As has been discussed in the prior Response, the Au film is arranged between the p-type semiconductor layer and the n-type transparent conductive film so as to prevent the formation of a p-n junction therebetween. To achieve this, the Au film must be thick enough so that it has a sufficiently high electrical conductivity (i.e. low resistivity) for this purpose. On the other hand, the Au film must be thin enough to remain substantially light transmissive so as to avoid impairing the light emission efficiency of the light-emitting device.

Thus, the setting of the Au film thickness in the range from 1 to 3 nm is critically significant in the present context for achieving a balance between these two opposing considerations (thin enough for light transmission and thick enough for low electrical resistivity).

The prior art neither disclosed nor suggested such a structural arrangement of an Au film between a p-type semiconductor layer and an n-type transparent conductive film, and would not have provided any motivation or suggestion toward the presently claimed film thickness range that achieves the required balance between the above described opposing considerations.

10) Regarding the claim feature that the n-type transparent conductive film is formed by laser ablation, this is not merely a

"product-by-process" feature, but rather an express physical limitation, because the transparent conductive film must have properties as result from the laser ablation. For example, as described in the present specification (see e.g. page 6, line 18 to page 7, line 19; and page 14, lines 2 to 14), the transparent conductive film formed by laser ablation has a surface that is significantly smoother (e.g. ten times smoother) than a typical surface of a film formed by sputtering, and also has a very high purity of the film composition, as well as a lower resistivity than can be typically achieved by conventional sputtering. These significantly improved properties make the transparent conductive film of the invention clearly identifiable as having been formed by laser ablation, rather than by sputtering, for example.

11) The prior art references, even when considered in combination, would not have suggested the presently claimed structural arrangement of an Au thin film having a thickness of 1 nm to 3 nm, arranged between the p-type semiconductor layer and the n-type transparent conductive film, wherein the transparent conductive film is formed by and has properties as result from laser ablation. The references will be discussed next, in comparison to these features of the claimed invention.

12) Ishibashi et al. disclose a light emitting device having a thin Au film (14) formed on top of a p-type semiconductor layer, with a relatively thick grid-shaped p-side electrode (13) of Au, Pd/Pt/Au or the like, arranged between the Au film (14) and the p-type semiconductor layer. Ishibashi et al. do not disclose the

thickness of the Au film (14) or of the p-side electrode (13) made of a Au. The top electrode structure thus involves the Au film (14), the p-type contact layer (12), and the grid-patterned p-side electrode (13) made of Au. Ishibashi et al. do not provide any suggestion or motivation toward arranging an Au thin film between a p-type semiconductor layer and an n-type transparent conductive film. In this regard, the Examiner turns to Kazuyoshi et al.

13) Kazuyoshi et al. disclose an ITO-type transparent conductive layer structure which is suitable for use as a transparent electrode.

The Examiner asserts "*Hence, it would have been obvious at the time the invention was made to add Kazuyoshi's InO/ZnO layer to Ishibashi's transparent Au thin film*" (emphasis added). The Examiner's assertion is respectfully traversed. There would have been no motivation to add another, completely redundant and unnecessary transparent electrode on top of a complete, fully functional transparent electrode structure of Ishibashi et al.

Neither Ishibashi et al. or Kazuyoshi et al. provide any suggestion or motivation to arrange an InO/ZnO layer **in addition to and on top of** a transparent Au thin film. The Ishibashi et al. device uses a top electrode structure of a grid-shaped p-side electrode of thick Au material (13) sandwiched between a transparent Au film (14) and a p-type contact layer (12). That is a fully functional and operational transparent electrode structure. On the other hand, Kazuyoshi et al. disclose an InO/ZnO transparent conductive layer which, by itself, is suitable for use and

fully functional as a transparent electrode, as pointed out by the Examiner.

There is no suggestion by either one of the references that there should be two distinct, fully functional top electrode structures stacked or piled on top of one another.

If anything, a person of ordinary skill in the art reading the Ishibashi et al. disclosure and the Kazuyoshi et al. disclosure together, might have been motivated to **replace** (but not combine) the top electrode structure according to Ishibashi et al. with the top electrode structure according to Kazuyoshi et al. There would have been no motivation to stack these two electrode structures on top of each other. The Ishibashi et al. reference does not suggest that there is any problem or deficiency of the disclosed top electrode structure, or that further improved results could be achieved by arranging yet another transparent electrode over the Au transparent layer (14). Similarly, Kazuyoshi et al. provide no suggestion that adding a transparent conductive layer of InO/ZnO on top of an already existing conductive electrode layer would achieve improved or beneficial results.

While a person of ordinary skill in the art might replace one known transparent electrode structure with a different known transparent electrode structure, he or she would not have been motivated to combine two of such structures on top of one another, due to the extra processing steps, costs, complexity, unnecessary redundancy, etc. and without any apparent or suggested benefits to be achieved by such doubling-up of transparent electrode structures.

14) The only suggestion in the present record toward applying an n-type transparent conductive film on top of an Au thin film, which in turn has been applied on top of a p-type semiconductor layer, such that the Au thin film is between the p-type semiconductor layer and the n-type transparent conductive film, comes from the inventive disclosure of the present application.

Such teachings of the application cannot be used to support a hindsight reconstruction of the inventive arrangement from bits and pieces of the prior art. In other words, the Examiner cannot use the inventive disclosure as a blueprint for picking and choosing various features from separate references and assembling those features in an arrangement according to the present claim being examined.

While the Examiner's comments have shown why a person of ordinary skill would have considered the teachings of Ishibashi et al. and Kazuyoshi et al. in combination with each other, and that an ITO-type layer is known as a transparent conductive electrode, the Examiner has provided no motivation in the prior art for arranging the ITO-type conductive film in addition to and on top of the Au thin film.

Why would a person of ordinary skill in the art have provided the ITO-type layer in addition to the Au transparent thin film when each of these structures alone was known to be a fully functional transparent electrode structure? Why not just provide the ITO film instead of the Au thin film? (The only motivation comes from the present application).

Even if the two known electrode structures were to be combined redundantly, why would a person of ordinary skill in the

art have provided the ITO-type layer on top of the Au transparent thin film? Why not arrange the ITO-type layer underneath the Au transparent film? (The only motivation comes from the present application).

The answers to the above questions, and the only motivations in this regard come from the present invention. For example, the present invention teaches why the Au thin film is significantly arranged between the n-type transparent conductive film and the p-type semiconductor layer, namely to prevent the formation of a p-n junction between these semiconductor layers, yet without deteriorating the light emitting efficiency. This is why the invention further critically requires the Au thin film to have a thickness in the range from 1 nm to 3 nm. The prior art provided no suggestions or motivations in this regard at all.

15) Regarding the thickness of the Au thin film, the Examiner refers to the Woodard et al. reference. This reference relates to the application of a metal layer onto a glazing film or glazing panel, for example such as a window glazing for a building, but may allegedly also be used for electronic devices.

The Woodard et al. reference relates to a non-analogous art in comparison to the field of the present invention and the Ishibashi et al. reference. For example, note the significantly different international and U. S. subject matter classifications of the Woodard et al. patent relative to the Ishibashi et al. patent. Thus, the Woodard et al. patent relates to a different field of endeavor.

Moreover, the Woodard et al. patent does not reasonably relate to solving the same problems that are to be solved by the present invention. As discussed above, with respect to the thickness of the Au film, the present invention aims to achieve a suitable balance between a sufficient conductivity to prevent the formation of a p-n junction (calling for the Au film to be thicker) and a sufficient light transmissivity to avoid impairing the light transmission efficiency of the device (calling for the Au film to be thinner). Woodard et al. have nothing to do with such a balance of opposing considerations, or solving such problems.

For these reasons, the Woodard et al. reference relates to a non-analogous art and cannot be applied in a rejection against the present invention.

16) Even if the teachings of Woodard et al. would have been considered in combination with those of Ishibashi et al. and Kazuyoshi et al., the present invention would not have been suggested.

The Examiner points out that Woodard et al. disclose the use of Au films in the presently claimed thickness range. However, the Au film according to Woodard et al. is <u>not disclosed or suggested as being suitable for use between a p-type semiconductor layer and an n-type transparent conductive film in a light emitting device as presently claimed</u>. Thus, even if a person of ordinary skill in the art would have considered the disclosure of Woodard et al., this person still would have found no teaching or suggestion whether the thickness ranges disclosed by Woodard

et al. would have been suitable in the presently claimed combination and arrangement.

The teachings of the reference cannot simply be taken out of the context of the reference and applied in the very different context of the present invention. Such teachings or suggestions applying to the context of the invention can only be found in the present application disclosure, which cannot be used to support the hindsight reconstruction of the present claims.

17) Moreover, the teachings of Woodard et al. actually would have motivated a person of ordinary skill away from the presently claimed thickness range in the presently claimed context.

For example, in Figs. 18 and 19 and col. 13, lines 60 to 67 of the reference, note that the light absorption and the electrical resistance of the Au film significantly increase as the "gold content factor" reaches and exceeds "X4" or "X8". According to the disclosure of the reference, those "gold content factors" of X4 and X8 correspond to Au film thicknesses of about 0.8 Å and 1.5 Å respectively (see e.g. col. 11, lines 52 to 54).

Thus, a person of ordinary skill in the art reading the Woodard et al. disclosure would have learned that it is theoretically possible to achieve Au film thicknesses overlapping the presently claimed range (in a different arrangement and context), but also that the light transmissivity and the conductivity both drop significantly once the gold film thickness exceeds about 1.5 Å or 0.15 nm.

When such teachings of Woodard et al. are considered in the different context of the present invention, and in the context

of the combination of Ishibashi et al. and Kazuyoshi et al., a person of ordinary skill in the art would have been motivated directly away from the presently claimed thickness range of 1 to 3 nm. A person of ordinary skill would have expected that such a thickness range would have an undesirably high light absorption and poor electrical conductivity, and instead would have been motivated to use Au film thicknesses less than 1 nm according to the disclosure of Woodard et al. transferred into the context of the present application.

18) The Examiner cannot take separate teachings of various references out of the context of those references and combine them using the context of the present invention as a blueprint for assembling those features. If the respective context of each of the three above discussed references is considered, it is clear that the combined references provide no suggestion toward the presently claimed structural arrangement of an Au thin film with a thickness of 1 to 3 nm between a p-type semiconductor layer and an n-type transparent conductive film, and the teachings of Woodard et al. regarding the properties of an Au thin film having certain thicknesses would actually have motivated a person of ordinary skill in the art away from the presently claimed thickness range. None of the references provides motivations to select or optimize a thickness range of an Au thin film based on the opposite considerations of avoiding a p-n junction formation while maintaining good light transmissivity.

19) Furthermore, twice amended claim 1 recites that the n-type transparent conductive film is formed by **laser ablation** and has properties as result from the laser ablation. For example, such properties include a smoother surface, a lower resistivity, and a higher compositional purity than can typically be formed by conventional sputtering.

The references of Ishibashi et al., Kazuyoshi et al. and Woodard et al. do not provide any suggestions in this regard. To the contrary, Kazuyoshi et al. expressly use a sputtering method for forming the ITO-type transparent conductive layer. Thus, the layer would not have such characteristics or properties as result from being formed by laser ablation.

With regard to the laser ablation, the Examiner has referred to the Mei et al. reference as teaching the use of "*laser ablation to generate relatively energetic doping atoms directly into the layer*" of semiconductor material. Even if the teachings of Mei et al. in this regard (col. 6, line 59 to col. 7, line 12) are taken in combination with the other references, the present invention would not have been suggested.

The present invention has nothing to do with generating and implanting dopant atoms into a semiconductor layer by a laser ablation technique as disclosed by Mei et al. Instead, the presently claimed invention involves a transparent conductive film that is entirely formed by laser ablation and has properties as result from the laser ablation. As described in the present specification (see e.g. page 6, lines 6 to 28; and page 12, line 11 to page 14, line 14), the present transparent conductive film is formed by using a laser to ablate a target material and

thereby emit atoms or molecular ions of the target material, and then depositing, oxidizing and growing a crystal structure from these deposited atoms or molecular ions.

The invention is quite different from the disclosure of Mei et al., which simply involves generating energetic doping atoms by laser ablation from a source layer, and then implanting those dopant atoms into a semiconductor substrate material so as to dope the semiconductor material. Appropriately, the technique of Mei et al. is called a laser doping process, while the process according to the present invention is a laser ablation film forming process that is used to form the presently claimed transparent conductive film having the corresponding resulting properties.

If the laser doping process of Mei et al. were to be considered in combination with the teachings of Ishibashi et al., Kazuyoshi et al. and Woodard et al., a person of ordinary skill in the art might have been motivated to apply such a laser doping process for forming one or more of the doped semiconductor layers of the overall structure of the light emitting device according to Ishibashi et al. However, a person of ordinary skill in the art would have found no application of such a laser doping process toward forming a transparent conductive film as presently claimed. The references do not teach anything about using laser ablation as a film forming technique.

20) The dependent claims are patentably distinguishable over the prior art at least due to their dependence from claim 1. Regarding claim 5, the Examiner's remarks on page 4 of the Office

Action seem to be referring to the "flattened" terminology of original claim 5, rather than the present amended status of claim 5. Present claim 5 recites that the transparent conductive film has a greater surface roughness than the Au thin film. The Examiner has not addressed this limitation of the relative surface roughness of the transparent conductive film in comparison to the Au thin film.

21) For the above reasons, the Examiner is respectfully requested to withdraw the obviousness rejections applying Ishibashi et al., Kazuyoshi et al., Woodard et al., and/or Mei et al.

22) Favorable reconsideration and allowance of the application, including all present claims 1 and 4 to 6, are respectfully requested.

Respectfully submitted,

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_____ 2/18/02
Walter F. Fasse - February 18, 2002

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"MARKED-UP VERSION"

1. (twice amended) A semiconductor light-emitting device comprising:

a substrate; [and] (an # n-type lower electrode provided on a back surface of said substrate[.];

a light-emitting layer provided on said substrate;

a p-type semiconductor layer provided on said light-emitting layer;

an Au thin film provided on said p-type semiconductor layer and having a thickness of 1 nm to 3 nm; and

an n-type transparent conductive film provided on said Au thin film, with said Au thin film between said p-type semiconductor layer and said n-type transparent conductive film[.], wherein said n-type transparent conductive film is formed by laser ablation and has properties as result from the laser ablation,